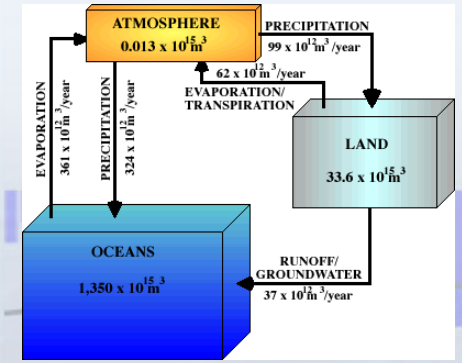
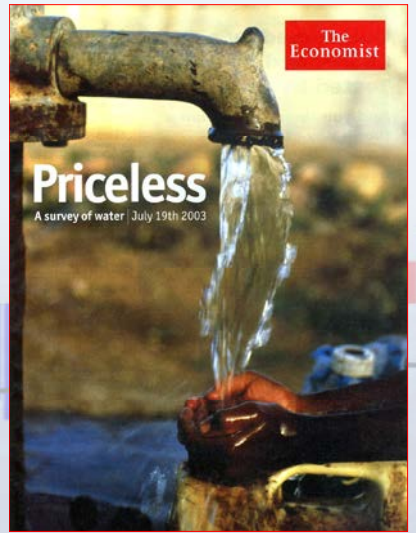
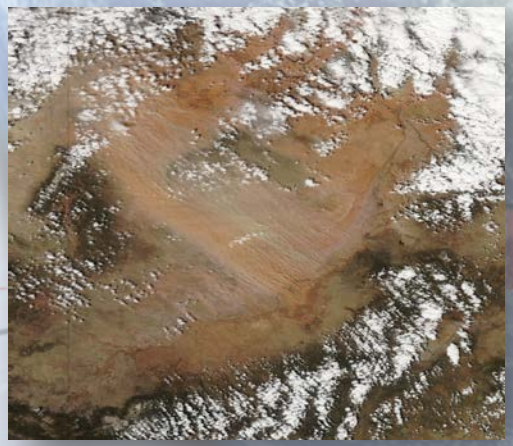
People, thresholds and knowledge

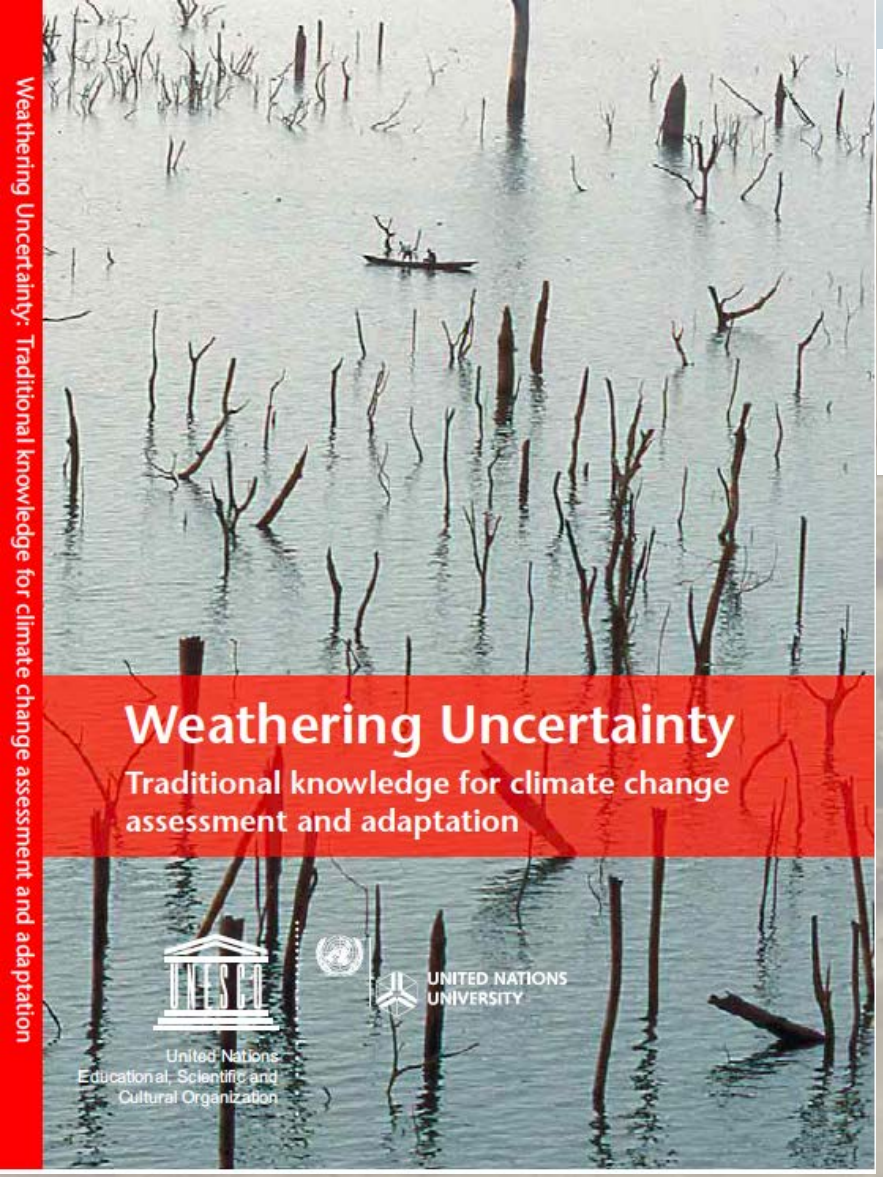
Margaret Hiza Redsteer USGS

Roger S. Pulwarty NOAA









Weathering Uncertainty

Traditional Knowledge for Climate Change Assessment and Adaptation

Convention on Biological Diversity

gef
The GEF Small Grants Programme
UNDP

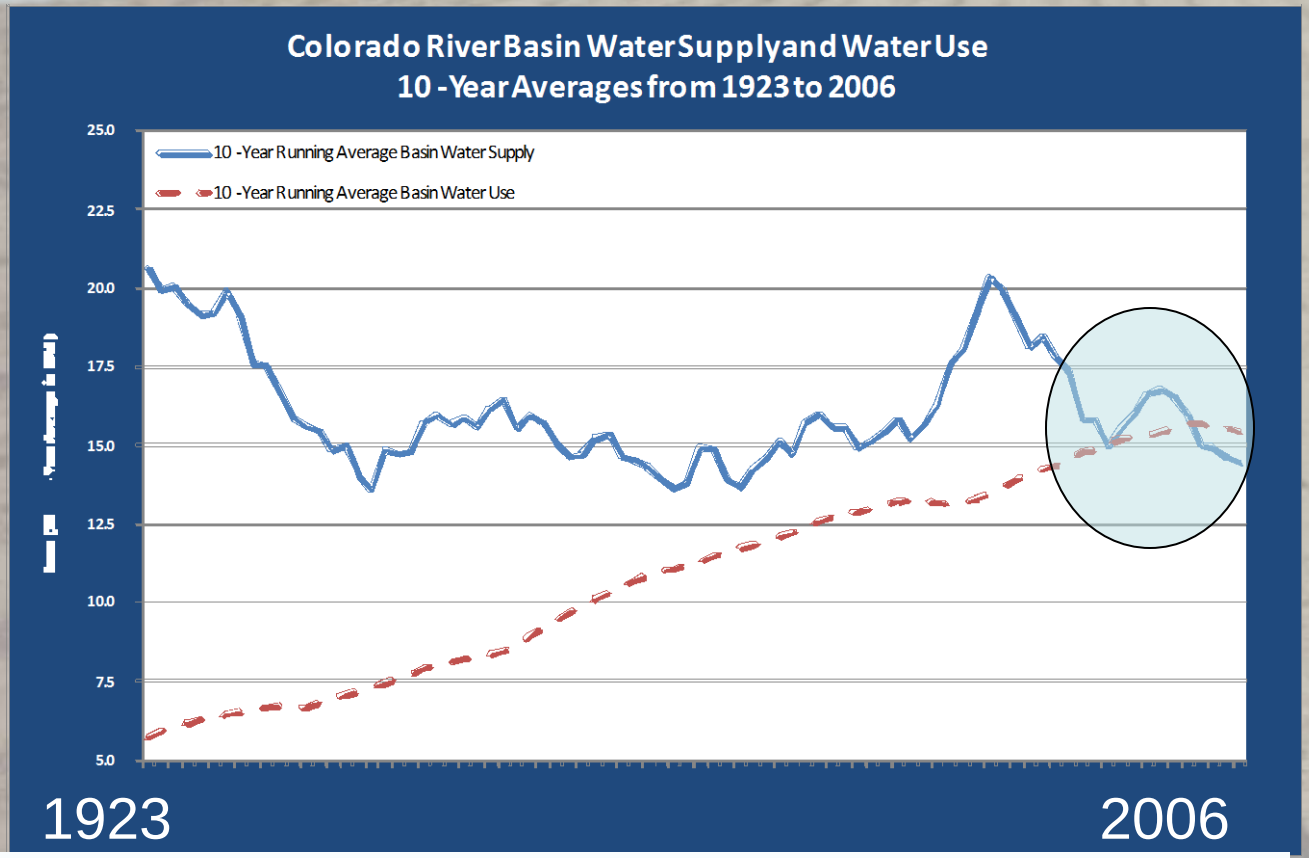
United Nations Educational, Scientific and Cultural Organization
climate frontlines
Natural Sciences Sector
Local and Indigenous Knowledge Systems Programme

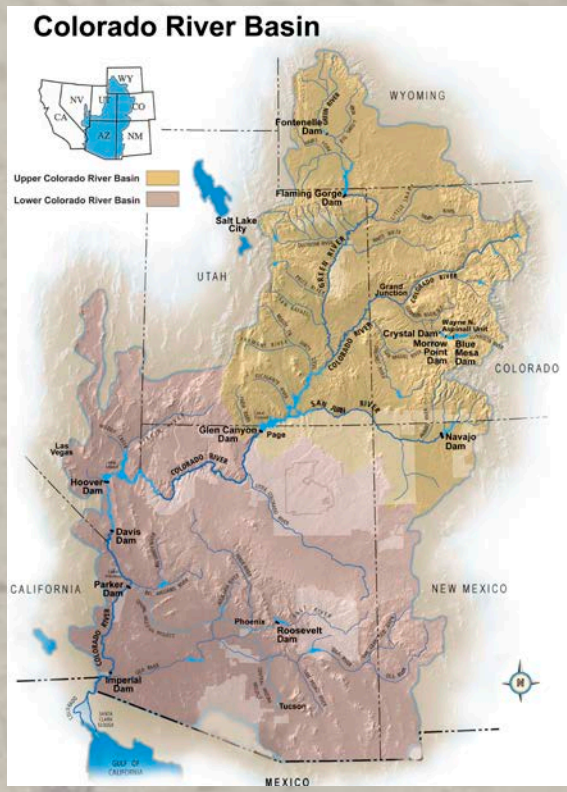
UNITED NATIONS UNIVERSITY
UNU-IAS
Institute of Advanced Studies
Traditional Knowledge Initiative

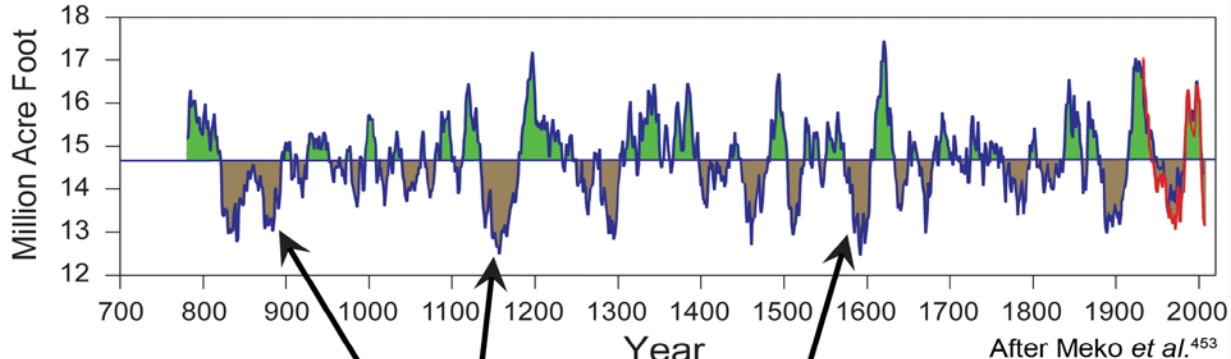
A growing number of movements and networks

Many Native peoples live in the harshest environments of the world

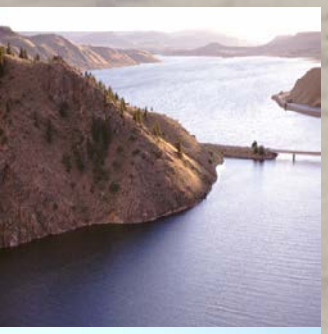
Colorado River Water Supply & Use

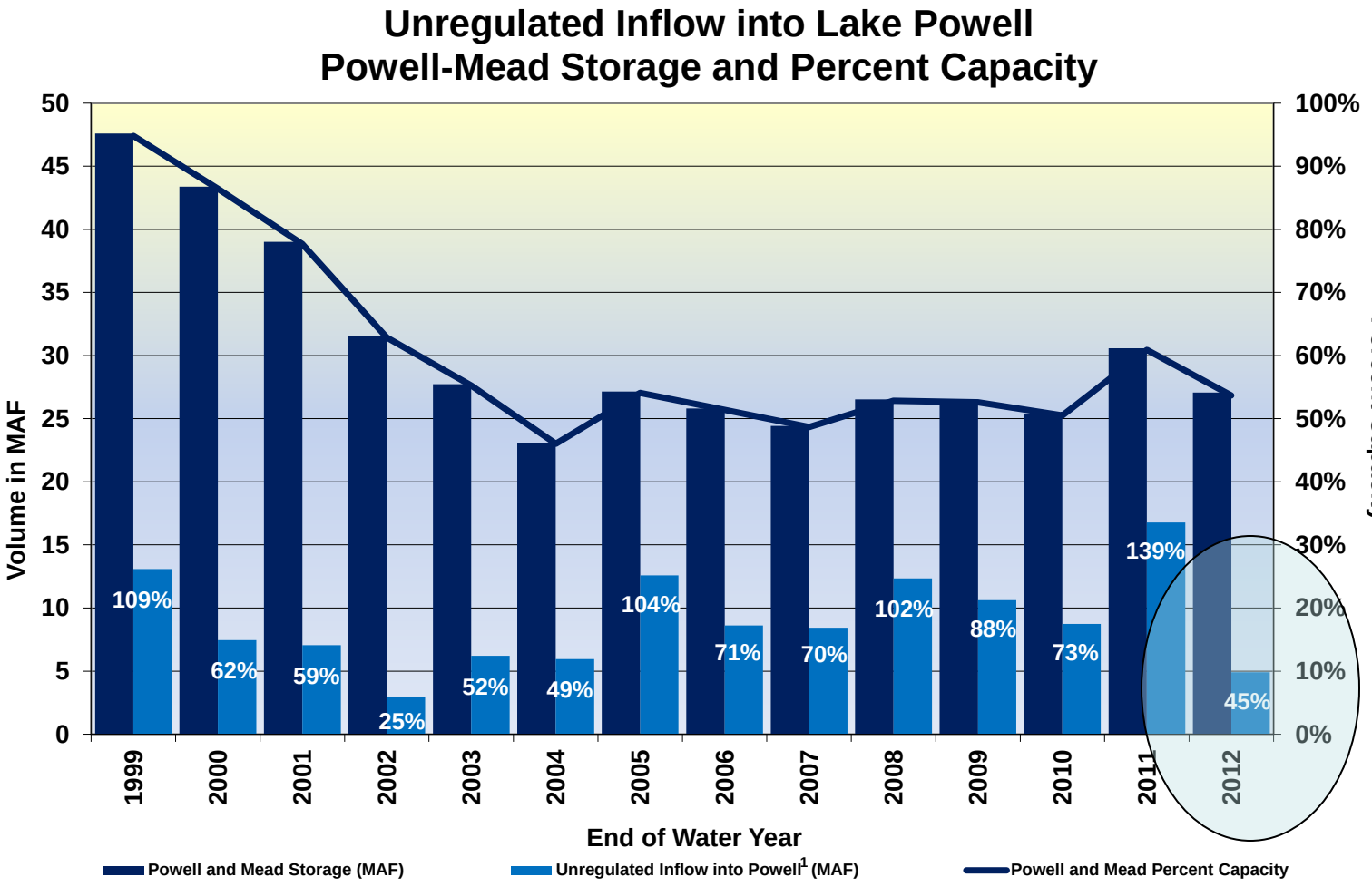






State of the System (Water Years 1999-2012)[1]





[1] Percentages at the top of the light blue bars represent percent of average unregulated inflow into Lake Powell for a given water year. Water years 1999-2011 are based on the 30-year average from 1971 to 2000. Water year 2012 is based on the 30-year average from 1981-2010.

In the Colorado River's 100-year recorded history, 1999 through 2010 ranks as the second-driest 12-year period

Drought and Climate Change Part II
Diné/Navajo and the Four Corners Region

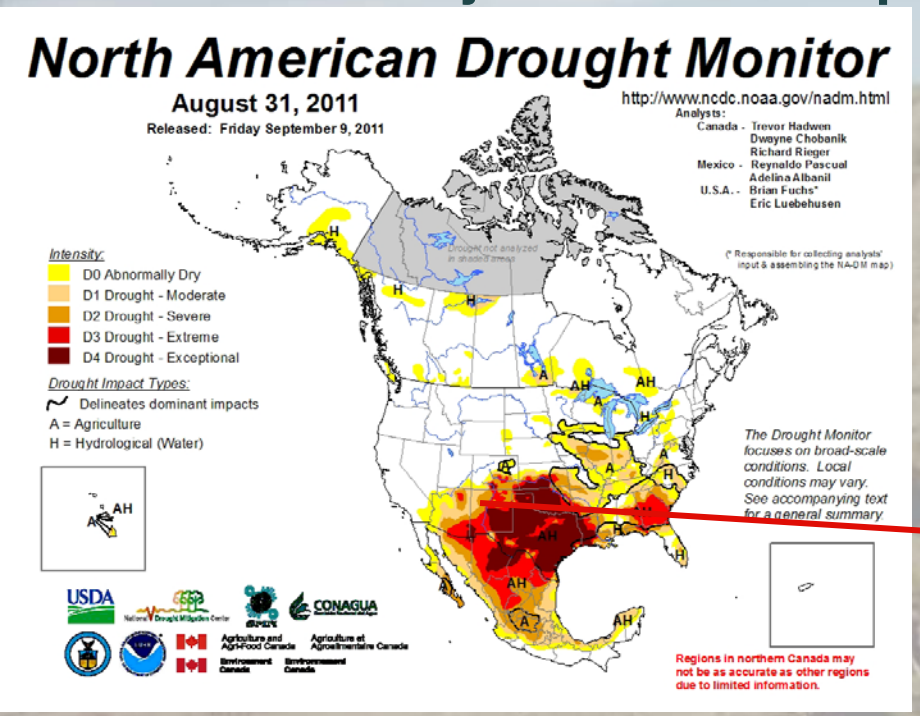
Native Nations in Southwest US are major land managers

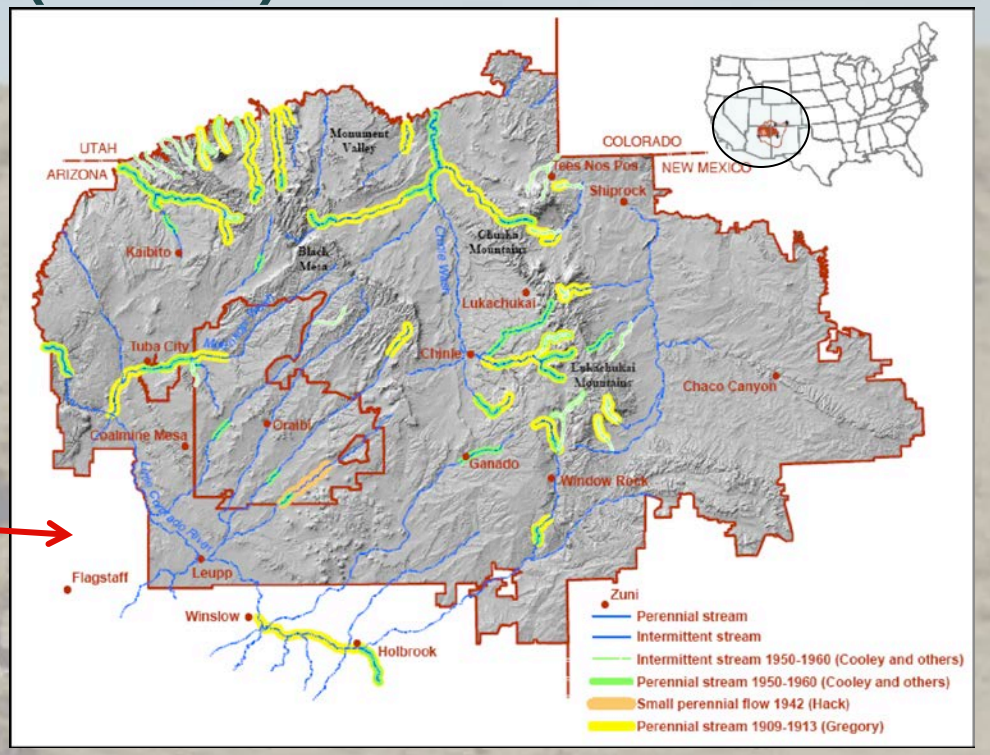
Regional Characteristics

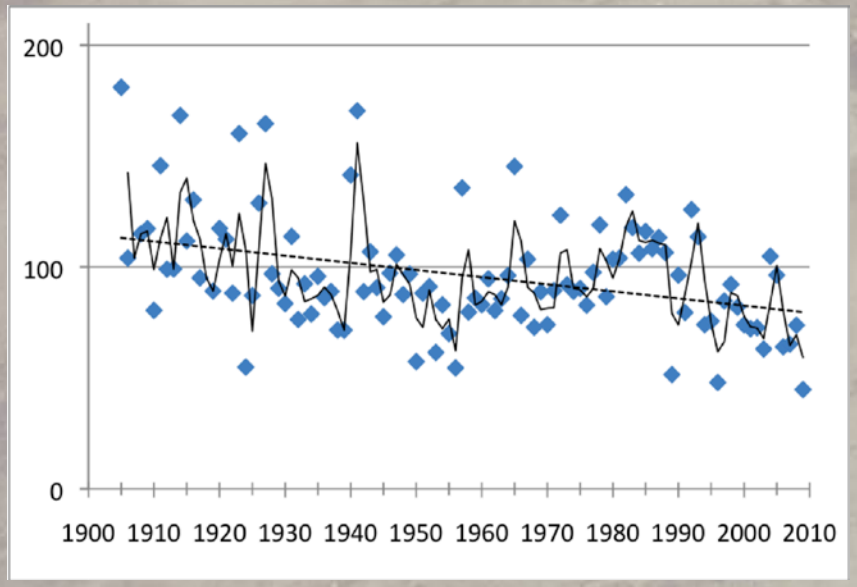
Reservation history and local land tenure

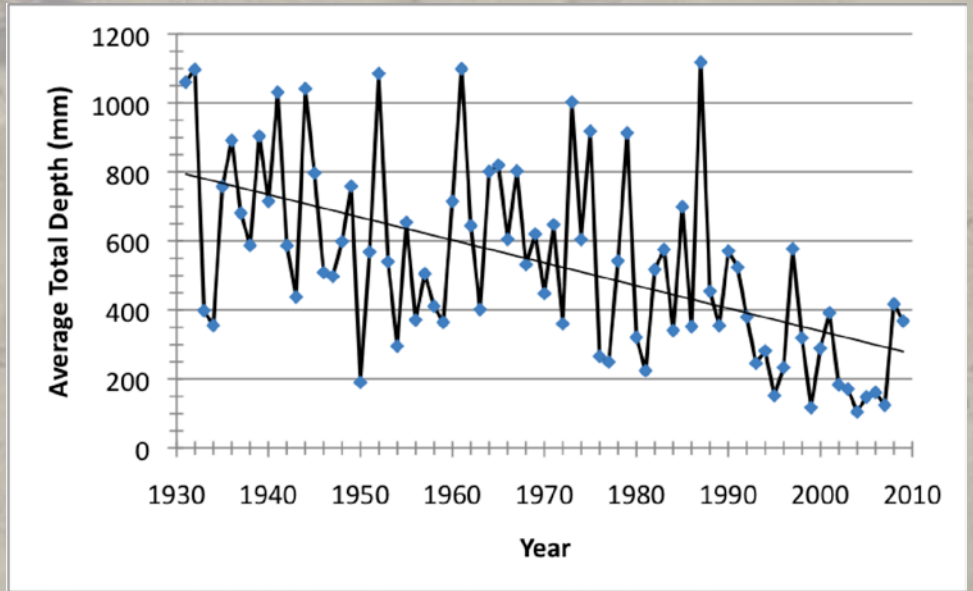
Drought and climate change: Thresholds

Navajo/Dine and Hopi (rain-fed) Homelands









Changing Streamflow

Photographs of the stream flow in Wheatfields Creek upstream of Wheatfields Lake in April 2005 (left) and April 2006 (right).

Slide courtesy of Jolene Tallsalt Robertson, Navajo Nation Dept of Water Resources

Rivers Flowing Less Often:

Changes In Perennial Flow

Only remaining Perennial flow

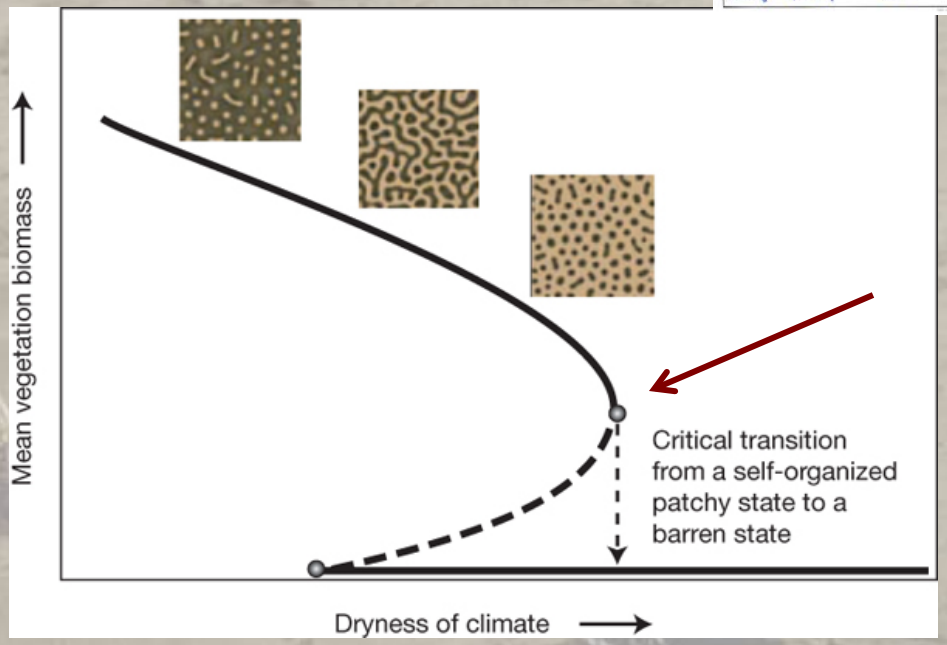
UTAH
ARIZONA
COLORADO
NEW MEXICO
Monument Valley
Tees Nos Pos
Shiprock
Kaibito
Black Mesa
Chuska Mountains
Chinle Wash
Lukachukai
Tuba City
Moenkopi
Chinle
Lukachukai Mountains
Chaco Canyon
Oraibi
Coalmine Mesa
Ganado
Window Rock
Little Colorado River
Flagstaff
Leupp
Zuni
Winslow
Holbrook

Perennial stream
Intermittent stream
Intermittent stream 1950-1960 (Cooley and others)
Perennial stream 1950-1960 (Cooley and others)
Small perennial flow 1942 (Hack)
Perennial stream 1909-1913 (Gregory)

USGS

Landscape changes- Native American Lands in the Four-Corners Region-Early-warning signals for critical transitions

Mean vegetation biomass



Dryness of climate

(Nature, 2009, Redsteer, 2011 UNISDR, NIDIS 2012)


LOCAL NEWS

Comments 2 | Recommend 0

Multiple crashes due to wind and dust along I-40

More Phoenix Local News

09:21 PM Mountain Standard Time on Thursday, March 26, 2009

Sand Dune Mobility = W/(P/PE)

Stable Sand Dunes
= P/PE > 0.31

Partly Active Dunes
P/PE = 0.31-0.13

Fully Active Dunes
P/PE< 0.13


Direction of sand transport

OBSERVATIONS FROM 73 ELDERS:

Changes in Weather

- Today less rain & snow (all)
- In late 1930s - 1940s climate began to shift from wet to dry (oldest)
- In the 1920s and 1930s it rained a lot, rains could last for a week.
- In the 1930s it snowed deeper
- In the 1940s the snow was big, chest high on the horses (15)
- The climate has gotten drier since 1944 (8)
- More moving sand &dust starting in 1950's
- In 1954, 1962 and 1999 there were strong wind storms
- Until 1971 enough water in streams to grow crops
- Since the 1990s there is drought & heat
- Now it's hotter with more wind

OBSERVATIONS FROM 73 ELDERS:

Environmental Changes

- Springs and Lakes drying up
- Rivers flowing less often
- Disappearance of Beavers, Cranes, Herons, Egrets, Eagles, Lizards
- Very few bees & locusts
- Until 1944, the ground stayed moist until July (Monsoon season)
- Until late 1970s there was enough water and people planted crops
- Disappearance of cottonwood trees, willows, ceremonial and medicinal plants
- Ceremonialists traveling farther to cooler, wetter high elevations for medicines
- New plants with no Navajo names

Current Challenges from Drought 1994-2012 drought mitigation- extra hay, water trucks

- SPI Information from climate divisions rather than local data used to declare drought
- Drought means no water to drink
- Visible rangeland changes: no forage for livestock
- Poor Socioeconomic Conditions leave few alternatives

How does one mitigate this???

Past Adaptation Strategies

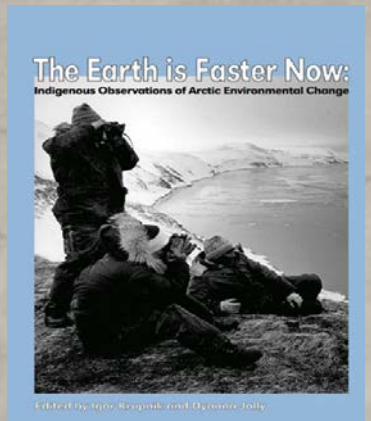
- **Movement of livestock within a broader region shared by extended families**
- **Kin-based sharing of resources,**
  - **movement away from drought affected areas**

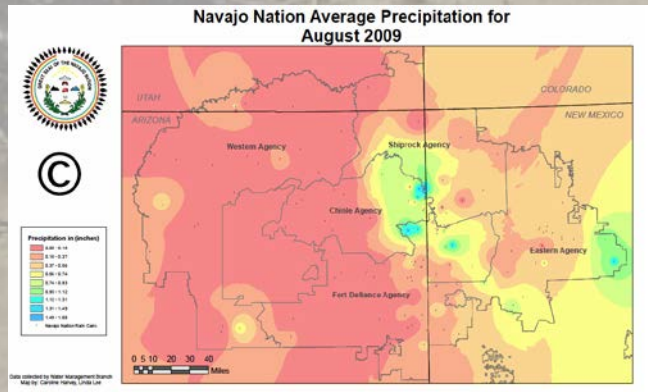
These ways are discouraged by the current grazing and land use policies,

Now land and water disputes are common

What does/will drought+warming mean for tribes in the SW?

- Threatens livelihoods (e.g. ranching) and vital cultural practices (e.g. dryland farming)
- Landscape changes (e.g. sand dune migrations) threaten habitation and infrastructure
- Ecosystem changes mean access to traditional plants and animals may be limited
- **Throughout much of Indian Country, there is a lack of quality climate data to support adequate monitoring of climate conditions**

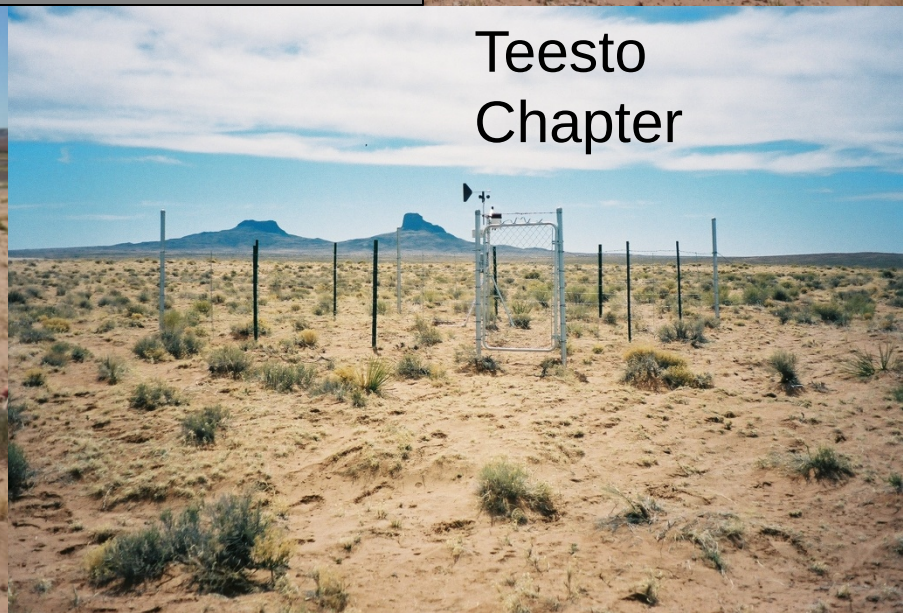




Traditional Knowledge and Perspectives:

- Increases our ability to understand changing environmental conditions
- Refines timing of events
- Fills monitoring gaps

Monitoring Sites



Dune stability work 2011

Rice grass planting has been successful

But more challenges lie ahead

Scenarios: Diné/Navajo Lands

Through conversations before and during workshops, the team identified the most important and most uncertain climate drivers that will affect conditions over the next 40 years. These were combined in the following matrix. (Also note that temperature increase was a 'given' so it applies in all scenarios

Shrubland

Ecosystem becomes more susceptible to annual grass invaders. Fate of pines and other trees uncertain. Soil erosion increases. Faunal composition changes.

Flash floods entering caves more often

Native grassland replaced by shrubland and exotic annuals

Ponderosa pine communities more susceptible to catastrophic fires due to decreasing summer precipitation

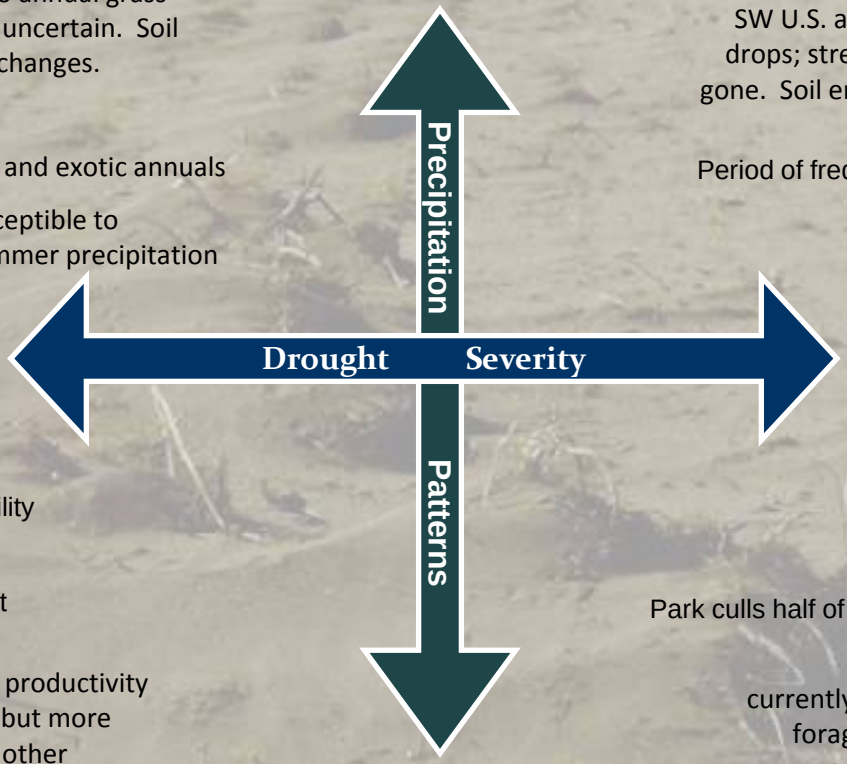
Patterns shift – more winter precipitation relative to summer

Novel Ecosystem

Climate changes quickly to something like southern SW U.S. and species migration limited. Water table drops; streams go from perennial to intermittent or gone. Soil erosion increases. Many fauna may not be sustainable.

Period of frequent, intense fire followed by decrease in fire because of lack of fuel

Tough decisions regarding above-ground mission



Duration and Frequency change little

Extreme Droughts become far more common

Changes seen as part of normal variability

Other management issues dominate

Streams more intermittent, trees dry out

Increased evaporation decreases plant productivity somewhat; ecosystem change occurs, but more slowly and/or to lesser degree than in other scenarios.

Extreme heat events – camp fire bans

Decreased water availability

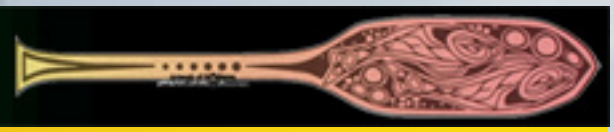
Park culls half of the bison herd – limits on carrying capacity

Forest is more restricted by moisture than currently. Megafauna capacity decreases because forage production is lower. Water table drops; spring and stream flow decreases or ceases, depending on location.

Patterns change little

Mixed-grass Prairie

Shortgrass Prairie



SWINOMISH CLIMATE CHANGE INITIATIVE

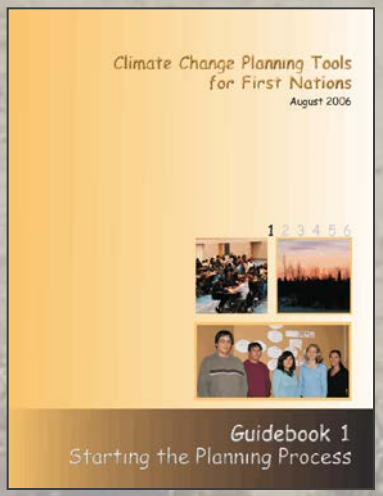
Tribal Principles for Climate Legislation

Tribes, Climate Change and Solutions

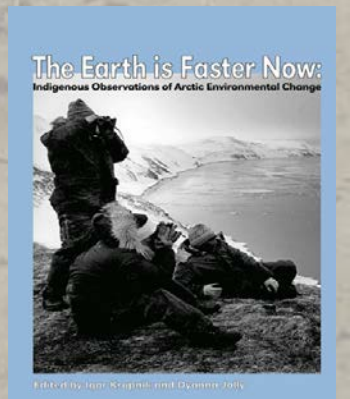
Tribal Energy Solutions to Climate Change Workshop

(Bilings, MT - April, 2008)

Henry Red Cloud from Lakota Solar Enterprises demonstrates low-cost and energy efficient solar heating panels to participants.
© Alexis Bonogofsky, 2008



HUALAPAI TRIBAL NATION



What are the impacts of climate change &/or drought??
How should they be documented?
How is control to be exercised?

Accounts of Traditional Elders &

-Extension of data records to include physical dimensions in the environment otherwise unobtainable

-Additional information that provides insights into the physical processes at work that are effecting the local ecology

-Tthe area is poorly monitored, accounts provide additional lines of evidence, and more complete characterization of changes over the long-term

Monitoring Site

Coalmine Chapter

Leupp Chapter

Teesto Chapter

Four dimensions:

- substantive-there are differences in the subject matter and characteristics of indigenous vs. western scientific traditions;

- methodological and epistemological - the two forms of knowledge employ different methods to investigate reality, and possess different world-views; and

- contextual - traditional and western knowledge differ because traditional knowledge is more deeply rooted in its context

- Multiple domains and types of knowledge- Objectivity: bringing all relevant information to bear on a problem

The likelihood of failure without using indigenous knowledge

- new frames for integration,
- greater cognizance of the social contexts of integration,
- expanded modes of knowledge evaluation, and
- involvement of inter-cultural “knowledge bridges”

Work cooperatively with other federal agencies on matters that affect Indian country or a Tribe’s interests.

So what is needed now?

Jolene Tallsalt Robertson
Hydrologist, Navajo Nation Department of Water Resources

Dr. Margaret Hiza
US Geological Survey

Rachael Novak
US Environmental Protection Agency

Casey Kahn-Thornbrugh
Adjunct instructor of Geography
Tohono O’ odham Community College

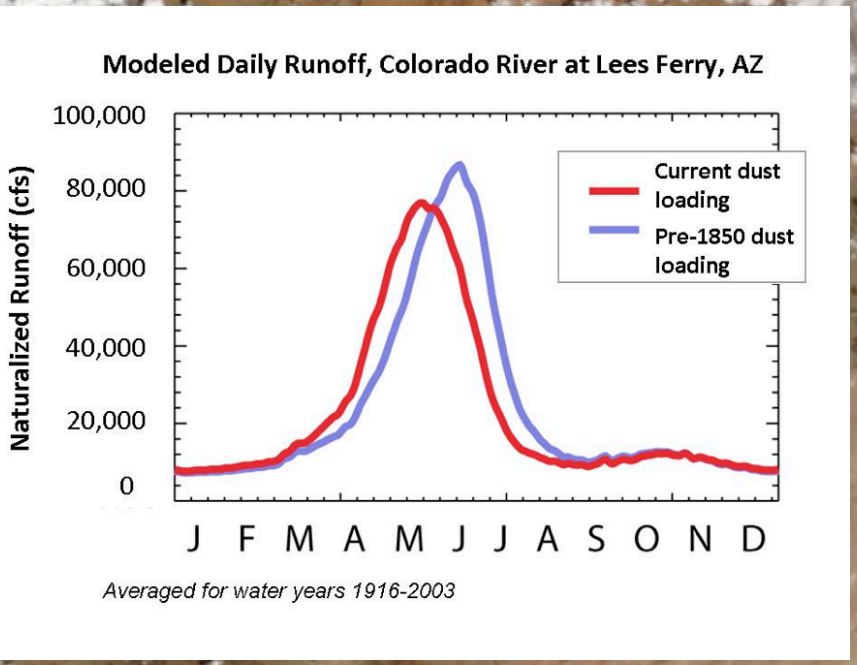
More Native researchers (cultural, social, physical, natural) to work for their communities

Climatic drivers of drought- a continuum

Droughts span an enormous range of time scales

Droughts are caused by a number of complex variables-land surface feedbacks

Dust from NE Arizona

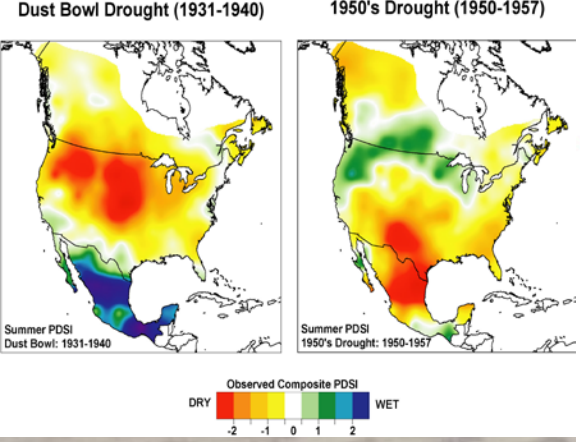


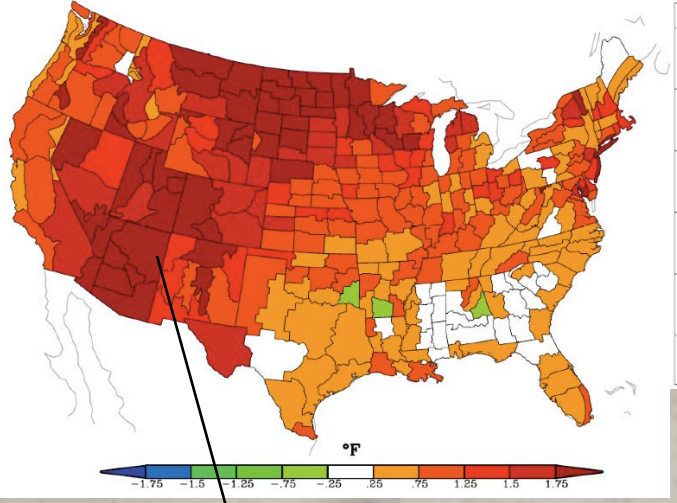
Ecosystem-based drought assessment and mitigation leads to better evaluation

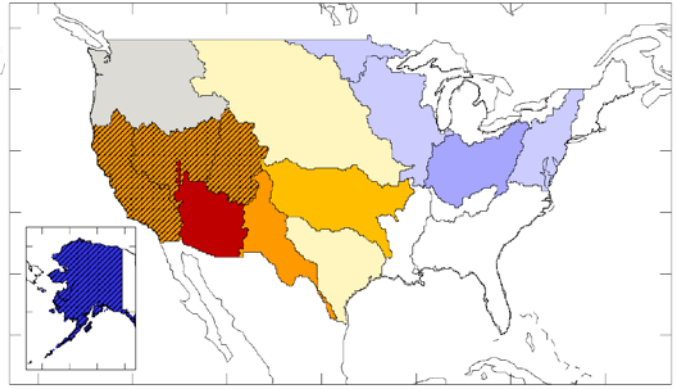
- Rangeland health is ecosystem-based
- Resilience (ability to handle or ride-out impacts) – ecosystems
- Large scale disasters, such as the Dust Bowl

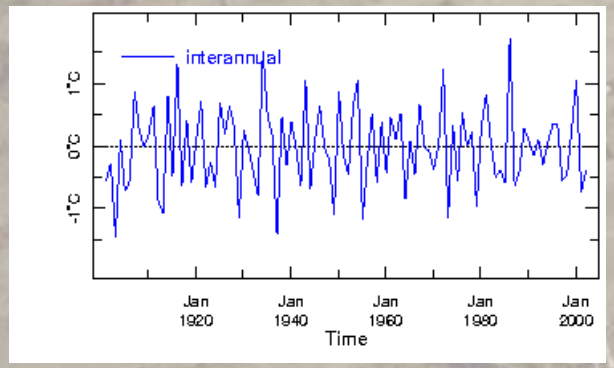
<u>Mitigation</u>
<u>approaches can be</u>

Looking at drought in relationship to ecosystems allows for a wholistic view of the influences of land use and societal issues that can lead to better resilience or more









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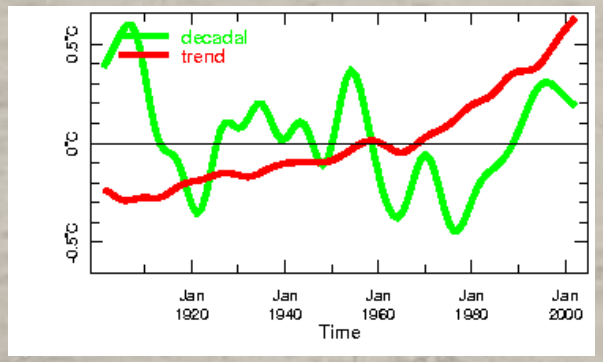

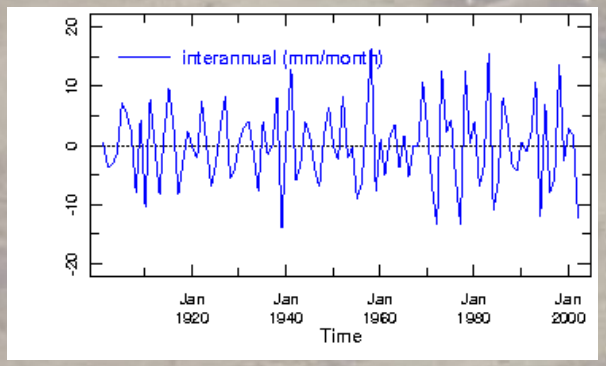

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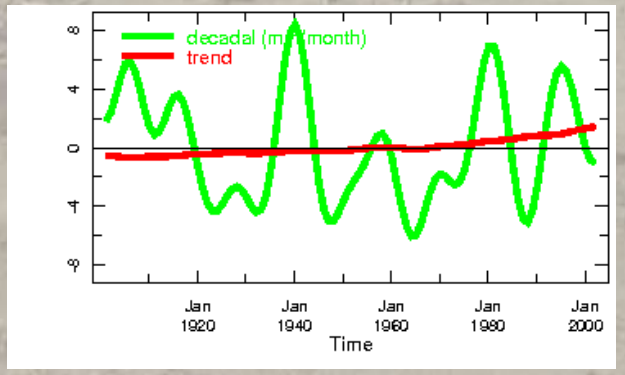
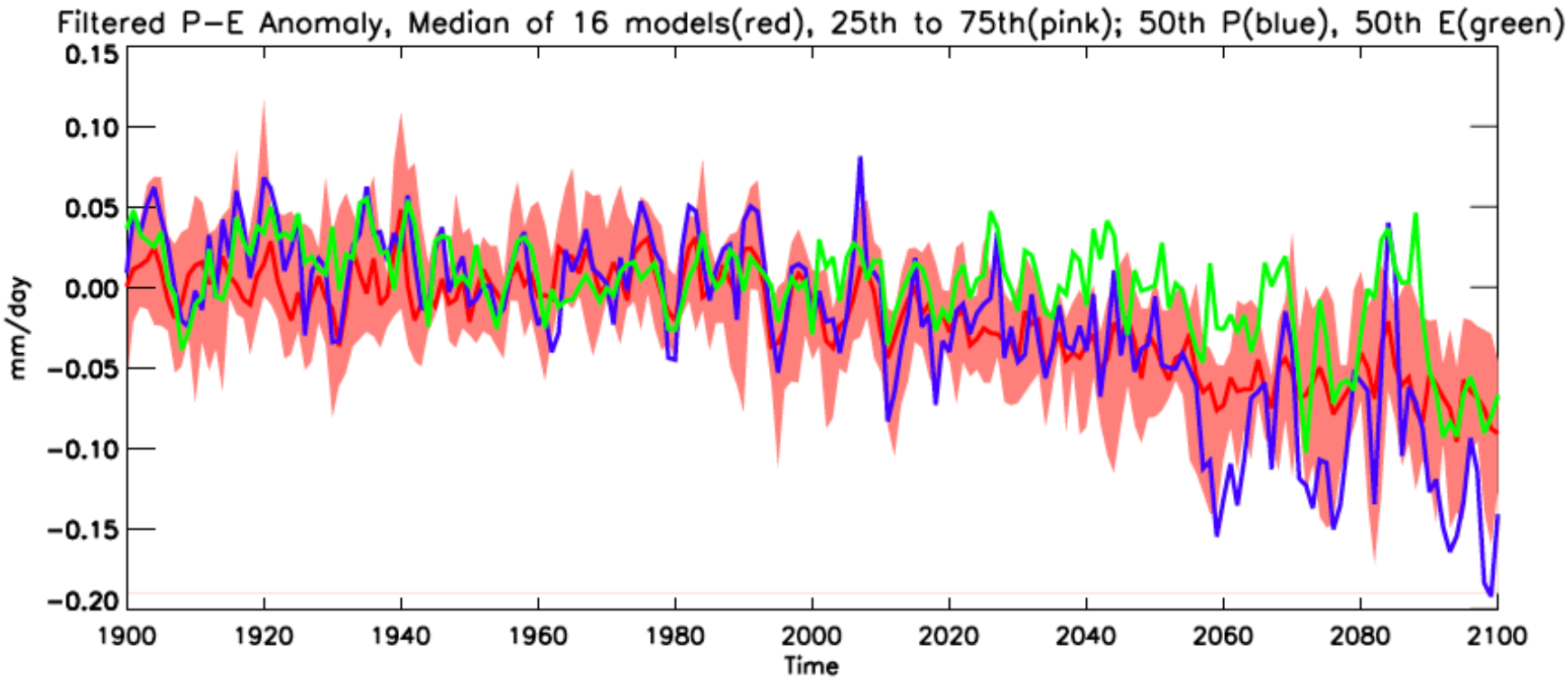


Changes in Average Annual Temperature
1º C increase =>50mm precipitation lost to ET

P, E and *P-E* averaged across all of SW North America in the IPCC AR5 global climate model simulations and projections for 1900 to 2100



Ongoing transition to a drier climate driven by decreasing precipitation

Seager, 2012)

ADAPTHOME-

Alliance For **D**rought **A**wareness And **P**articipation **T**owards **H**elping **O**ur **M**other **E**arth